

Thermodynamic Property Measurements Near the ^3He Liquid-Gas Critical Point

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Abstract

NASA is planning a microgravity experiment called MISTE (Microgravity Scaling Theory Experiment) that will perform a set of thermodynamic measurements near the ^3He liquid-gas critical point. The primary objective of this experiment is to measure the heat capacity at constant volume and the isothermal susceptibility throughout the critical region. An additional guest investigation called COEX (Coexistence Boundary Experiment) will measure the shape of the coexistence curve using the heat capacity anomaly upon crossing the first-order transition. The attainment of these microgravity measurements, primarily along the critical isochore and coexistence curve, should provide a stringent test of scaling theory predictions in the asymptotic region. This talk will provide an introduction to these future flight experiments and discuss some of the issues being addressed to attain a successful mission. Over the years, many ground-based studies were performed near liquid-gas critical points to elucidate the expected divergences in thermodynamic quantities. The unambiguous interpretation of these studies very near the critical point was hindered by a gravity-induced density stratification. However, these ground-based measurements can give insight into the crossover behavior between the asymptotic critical region near the transition and the mean field region farther away. The results of experimental tests of the predictions of crossover models will be presented.